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WATER QUALITY CONTROL STUDY LOMPOC PROJECT, SANTA BARBARA COUNTY, CALIFORNIA

Federal Water Pollution Control Administration
San Francisco, California

July 1967

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SANTA YNEZ RIVER BASIN

LOMPOC PROJECT

WATER QUALITY CONTROL STUDY

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DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA
JULY, 1967

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WATER QUALITY CONTROL STUDY
LOMPOC PROJECT
SANTA BARBARA COUNTY, CALIFORNIA

ABSTRACT

The Lompoc Project will develop approximately 20,000 acre-feet of water per year for industrial and municipal uses. Due to waste discharge practices and negligible downstream beneficial uses, flow regulation for water quality control will not be required below Lompoc Reservoir. A water supply benefit of $4,930,400 is attributable to the higher quality of the Lompoc Project water as compared to the present supply.

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
San Francisco, California

JULY 1967

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I. INTRODUCTION

AUTHORITY

The study described in this report was made in accordance with 1) the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.); and 2) Executive Order 11288, July 2, 1966.

PURPOSE AND SCOPE

The purpose of this report is to describe 1) the need for and value of reservoir storage for streamflow regulation for water quality control; and 2) the potential impact of the project on water quality. The study is limited to the drainage area of the Santa Ynez River downstream from the proposed project reservoir and the reservoir itself. The study period 1970 to 2020 is considered.

ACKNOWLEDGEMENTS

The following agencies have provided valuable assistance in the preparation of this report:

U. S. Bureau of Reclamation
Sacramento, California

Department of Defense, U. S. Air Force
Vandenberg Air Force Base, California

U. S. Bureau of Sport Fisheries and Wildlife
Sacramento, California

Central Coastal Regional Water Quality Control Board
San Luis Obispo, California

California State Department of Public Health
Santa Barbara, California

Department of Public Works
Lompoc, California

Vandenberg Water Company
Vandenberg Village, California

II. SUMMARY OF FINDINGS AND CONCLUSIONS

FINDINGS

1. The Santa Ynez River Basin drains approximately 900 square miles of southern Santa Barbara County, California. Annual runoff to the Pacific Ocean near Surf, averaged 20,000 acre-feet for the period 1953-1965.

2. The 1967 population of the service area is approximately 50,000 persons and is concentrated in the vicinity of Lompoc and Vandenberg Air Force Base, California.

3. The economy is primarily dependent upon Vandenberg Air Force Base and agricultural activity.

4. The major source of municipal, industrial, and agricultural water supply is ground water. Present development of surface water has been limited primarily to export use in the Santa Barbara area.

5. The estimated average annual pumpage from ground water in the Lompoc area, is 27,400 acre-feet. The perennial safe yield is estimated to be 25,000 acre-feet.

6. Ground water levels are declining and the concentration of chlorides and sulfates is increasing.

7. The ground water presently being utilized to meet municipal and industrial water requirements in Lompoc, Vandenberg Village, and Mission Hills has weighted average total dissolved solids concentration of 1170 mg/l and a hardness of 650 mg/l. Following treatment the city of Lompoc is presently providing a water supply with an average total dissolved solids concentration of 900 mg/l and a hardness of 150 mg/l.

8. Ground water presently being used at Vandenberg Air Force Base has total dissolved solids concentration of 1270 mg/l and hardness concentration of 500 mg/l before treatment.

CONCLUSIONS

1. The population of the Lompoc sub-area is projected to increase from 46,355 in 1965 to 197,000 by the year 2020.

2. Annual municipal and industrial water requirements for the Lompoc sub-area will reach approximately 51,000 acre-feet by the year 2020.

3. Local water resources will not be adequate to meet the water requirements of the area.

4. In the future, uncontrolled discharge of treated municipal and industrial waste water directly to the Santa Ynez River should be prohibited. Waste effluents should be discharged to the ocean or reclaimed by recharge to the ground water reservoir by controlled percolation facilities located in the river channel.

5. Beneficial use of the Santa Ynez River downstream from Lompoc Reservoir will be negligible in the future. Therefore, storage in that reservoir for flow regulation for water quality control will not be required.

6. The Lompoc Project will provide water with an average total dissolved solids concentration of 725 mg/l and an average hardness of 525 mg/l.

7. Benefits attributable to the difference in quality between the present local water supplies and water from the Lompoc Project will be $161,520 per year, equivalent to a total present worth (1970) of $4,930,400. These benefits accrue without storage for flow regulation for quality control. They are of the nature of water supply benefits, and therefore, do not meet the non-reimbursability requirements of Section 3b Federal Water Pollution Control Act as amended (33 U.S.C. 466 et seq.).

8. Certain precautions in the development and operation of Lompoc Reservoir are required to prevent water quality problems experienced in a similar nearby reservoir (Cachuma). These precautions include proper clearing of the reservoir area, proper location of outlet tower, multi-level outlet and, if necessary, provision for mechanical destratification. If possible, the reservoir bottom should be flushed out several times prior to use in order to collect debris and remove readily soluble nutrients.

III. DESCRIPTION OF THE PROJECT

The feasibility of developing a municipal and industrial water supply for the City of Lompoc, Vandenberg Village, Mission Hills, and Vandenberg Air Force Base is being studied by the U. S. Bureau of Reclamation in cooperation with the Santa Barbara County Water Agency. The proposed Lompoc Project will be located on the Santa Ynez River in Santa Barbara County, California. The dam site will be located about two miles east of the City of Lompoc. The project will consist of dams, reservoirs, and pumping and conveyance facilities. Additional functions of the project include recreation, flood control, and fish and wildlife enhancement.

The proposed project includes an earthfill dam which will have a storage capacity of 425,000 acre-feet, of which 280,000 acre-feet has been allocated to supply present and future municipal and industrial needs in the Lompoc Valley, and 20,000 acre-feet has been allocated to a minimum pool for general recreation and fish and wildlife purpose. The remaining 125,000 acre-feet will serve as inviolate flood control storage.

The annual yield of the reservoir for municipal and industrial use will be about 20,000 acre-feet. This water will be withdrawn from the reservoir through a multiple level outlet structure and pumped through Cabrillo Pumping Plant into Cabrillo Reservoir. This detention reservoir will have a capacity of 2,600 acre-feet and a surface area of approximately 95 acres at an essentially constant surface elevation. Cabrillo Reservoir will provide a minimum detention time of thirty (30) days. The California Department of Public Health requires that when water contact sports are permitted in reservoirs from which water is withdrawn primarily for domestic purposes, such water be detained a minimum of thirty days without further body contact before it is permitted to enter a municipal water system, or that an isolation area be provided where recreational activities in the vicinity of the reservoir outlet are prohibited.

IV. DESCRIPTION OF THE STUDY AREA

LOCATION AND BOUNDARIES

The study area is located on the California coast in the southern part of Santa Barbara County. The location and study area map is shown in Figure 1. The study area is within the Santa Ynez River Basin, which extends inland from the coast for a distance of approximately 70 miles and is bounded on three sides by the San Rafael and Santa Ynez Mountains. It is a long narrow valley with an area of approximately 900 square miles.

The major stream in the valley is the Santa Ynez River which heads in the Santa Ynez Mountains near the Ventura County line and drains westward to the Pacific Ocean. Major tributaries of the Santa Ynez River include Salsipuedes Creek, Cachuma Creek, Santa Cruz Creek, and Mono Creek. The three existing impoundments located on the Santa Ynez River, i.e. Jameson Lake, Gibraltar Reservoir and Cachuma Reservoir, were developed primarily to export water from the basin to the coastal area of Santa Barbara County.

GEOLOGY

The Santa Ynez River Valley is divided into five sub-areas with respect to topography, geology, and hydrologic features. In downstream order, they are designated Headwater, Santa Ynez, Buellton, Santa Rita, and Lompoc [1]. The boundaries of the sub-areas are designated in Figure 1.

The Headwater Sub-area includes approximately one-half of the total basin, with rugged terrain and elevations over 5,000 feet. This area is underlain mainly by folded consolidated rocks and alluvial deposits along and beneath the river. The river bed broadens to a sizable flood channel 12 miles above San Lucas Bridge. A major portion of the annual runoff of the Santa Ynez River is drainage from this sub-area.

The Santa Ynez Sub-area includes approximately 6.5 miles of the river immediately downstream from the Headwater Sub-area. The area north of the river opens into a broad terraced upland known as the Santa Ynez Upland. This upland is 150 to 200 feet above the river and is underlain mainly with a thick body of unconsolidated deposits. The area is extensively cultivated and ground water is withdrawn from the unconsolidated deposits. The Santa Ynez Upland ground water basin is replenished by runoff from the San Rafael Mountains; discharge from the ground water basin is a major portion of the low flow of the Santa Ynez River below Cachuma Reservoir. The narrow inner valley is underlain with consolidated rocks, which prevent seepage from the river bed.

Buellton Sub-area includes the six miles of the river west of Solvang. The alluvial valley plain is approximately one mile wide and is bounded by consolidated rocks on the south and unconsolidated deposits on the north. The alluvial plain near Buellton is cultivated and water is pumped from the ground water reservoir and the river.

Santa Rita Sub-area is underlain by consolidated deposits except for the narrow band of alluvial deposits at the river. The area is bounded on the north by the Santa Rita Hills and the south by the Santa Rosa Hills. Salsipuedas Creek is a major tributary from the south.

The Lompoc sub-area covers the last ten miles of the Santa Ynez River above its mouth at the Pacific Ocean. This valley floor is known as the Lompoc Plain and is the principal agricultural area in the basin and includes the most productive water-bearing zones. The plain is bordered on the south by the foothills of the Santa Ynez Mountains and on the north by the Purisma Hills. The Lompoc Plain is underlain by unconsolidated material but the terraces to the north and south are comprised of consolidated deposits.

CLIMATE

The Pacific Ocean, which borders Santa Barbara County on two sides, has a moderating effect upon the temperature. The climate is characterized by long hot summers and short wet winters. However, the diurnal and seasonal temperature fluctuations are greater inland due to the effect of the Santa Ynez and San Rafael Mountains. Precipitation and mean, maximum, and minimum temperatures are shown on Table 1.

TABLE 1

TEMPERATURE AND RAINFALL

LOMPOC, CALIFORNIA

Period	Temperature (^{o}F)			Rainfall
	Min.	Mean	Max.	(inches)
January	40.2	51.8	63.3	3.04
April	45.0	55.4	65.7	1.93
July	52.7	61.6	70.6	0.05
October	46.8	58.8	72.8	0.32
Year	45.7	57.0	68.2	12.65

The prevailing winds blow from the Pacific Ocean at a mean hourly speed of 10 miles and are channeled into a southeasterly direction by the Santa Ynez Mountains. The growing season of the valley is shorter than that of the coast, but the winters are mild and highly favorable to agriculture.

Precipitation in the Santa Ynez River Basin varies widely with the season, from year to year and from place to place. Approximately 85 percent of the precipitation falls between December and April with only about 2 percent falling in June, July, and August. Snow occasionally falls on the San Rafael Mountains but does not influence streamflow greatly.

Low pressure storm centers generally move in from the west or northwest with moist warm air deflected upward by the 3,000 to 4,000-foot Santa Ynez Mountains. The result is precipitation that is heavy at the crest and some distance down the north slope. The average yearly precipitation at the crest is from 28 to 30 inches but is only about 14 inches at the northern foot of the mountains. The San Rafael Mountains, which bound the valley on the north, are 5,000 to 6,000 feet high and have an annual average precipitation of 30 to 31 inches. The average precipitation in the mountains at the eastern boundary of the basin is 40 inches. Approximately half the total rainfall in the basins falls in the area upstream from San Lucas Bridge and north of the river; and possibly two-thirds fall on the area upstream from San Lucas Bridge on both sides of the river [1].

V. WATER RESOURCES

SURFACE WATER

The use of surface water within the Santa Ynez River Basin is limited. Existing developments were provided in order to export water for use in Santa Barbara, Goleta, Carpinteria and Montecito. The export of water is accomplished by releases from Jameson Lake (capacity 7,000 acre-feet) through Doulton Tunnel; from Gibralter Reservoir (capacity 14,000 acre-feet) through Mission Tunnel; and from Cachuma Reservoir (capacity 205,000 acre-feet) through Tecolote Tunnel.

Flow in the Santa Ynez River is seasonal with zero flow often recorded during the summer months. The monthly distribution of total annual flow is shown in Figure 2. For the period since the construction of Cachuma Reservoir, 1953 to 1965, the average annual discharge of the Santa Ynez River to the Pacific Ocean has been approximately 20,000 acre-feet, and has varied from a maximum of 124,200 acre-feet to a minimum of 66 acre-feet [2].

GROUND WATER

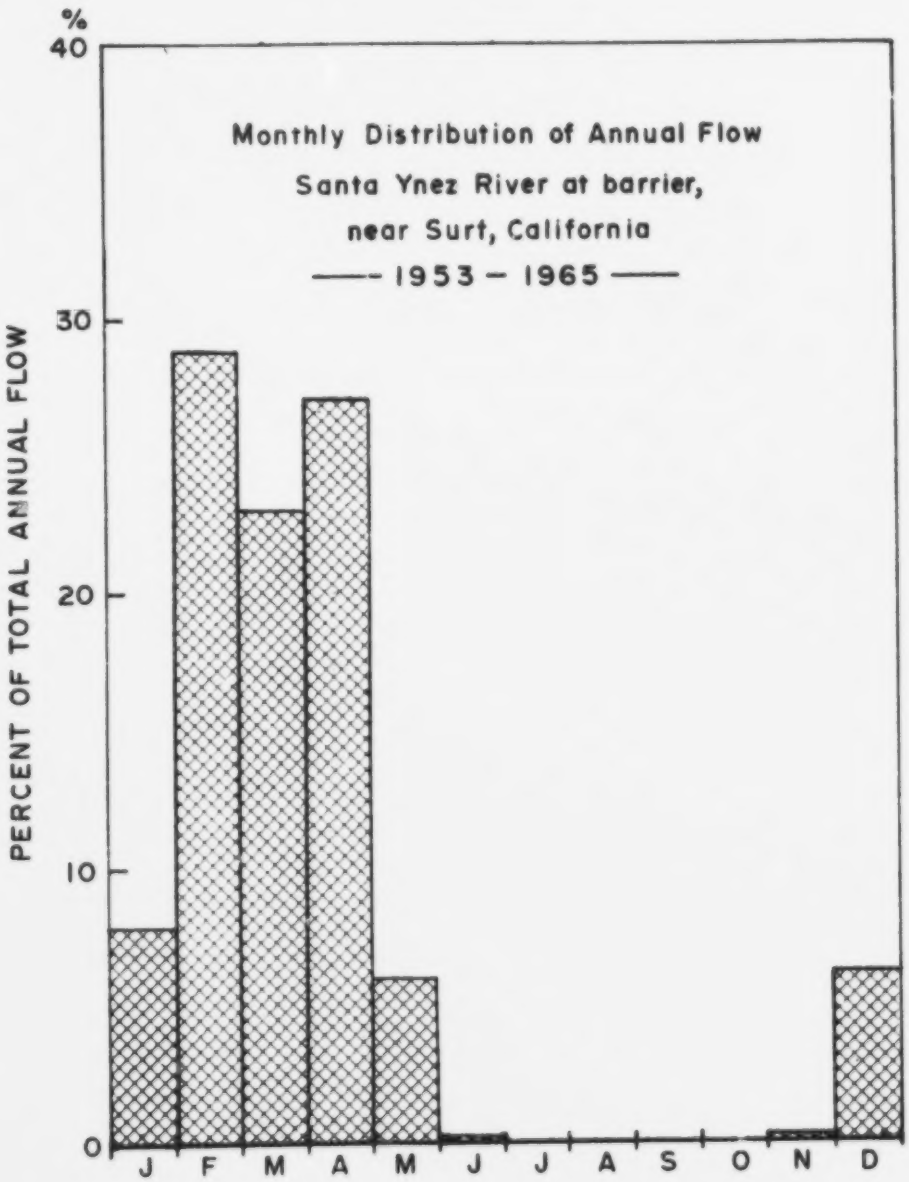
Domestic, industrial, and agricultural supplies are presently obtained from ground water, with the majority of the use centered in the Lompoc Plain. The estimated total pumpage of ground water for the Lompoc sub-area is shown in Table 2.

TABLE 2

GROUND WATER PUMPAGE
LOMPOC PLAIN a/
(Acre-Feet)

Year Starting May 1	Irrigation	Other Use	Total
1957	26,500	1,500	28,500
1958	18,900	3,200	22,100
1959	22,100	6,400	28,500
1960	22,100	7,600	29,600
1961	18,700	8,800	27,500
1962	20,200	8,700	28,900
Average	21,400	6,000	27,400

a/ Source: Evenson, R. E. [3].



LOMPOC PROJECT

MONTHLY ANNUAL FLOW
SANTA YNEZ RIVER

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA

Figure 2

The estimated perennial safe yield of ground water in the Lompoc sub-area is about 25,000 acre-feet [3,4]. The apparent overdraft of the ground water reservoir has resulted in declining water levels in parts of the Lompoc sub-area and has focused attention on the possibility of sea water intrusion if the overdraft continues.

The Santa Ynez Upland, located in the northern part of the Santa Ynez Sub-area is underlain by a ground water reservoir which is utilized as an irrigation supply. The perennial yield of this source is estimated at approximately 4,000 acre-feet [1]. This ground water reservoir supplies a major portion of the low flow of the Santa Ynez River, and thus, the quality of this water will directly affect water quality in Lompoc Reservoir. Ground water is also pumped from wells along the banks of the Santa Ynez River in the Santa Rita and Buellton sub-areas. This water is used principally for irrigation.

WATER QUALITY

Ground Water

The concentration of chlorides and sulfates in the ground water of the Lompoc Plain is increasing due to the concentrating effect of recycling irrigation water. Declining water levels also create a hydraulic gradient which drains elevated marine deposits of connate water of high chloride content into the ground water reservoir. Chloride and sulfate concentrations as high as 1500-1600 mg/l have been recorded.

The untreated municipal water supply for the Greater Lompoc Area (Lompoc, Vandenberg Village, and Mission Hills) has an average total dissolved solids (TDS) concentration of approximately 1170 mg/l and an average hardness of 650 mg/l. Ground water utilized by Vandenberg Air Force Base has a TDS concentration of 1270 mg/l and a hardness of approximately 500 mg/l. The following table shows typical chemical analysis of water wells used by the city of Lompoc.

TABLE 3 a/

CHEMICAL ANALYSIS OF WATER WELLS
LOMPOC, CALIFORNIA (mg/l)

Well No.	Date of Test	Calcium	Mg	Sodium	Total Hardness as $CaCO_3$	Total Alkalinity as $CaCO_3$	Total Dissolved Solids	Sulfates	Chlorides	Iron
1	5/23/60	145.6	68.3	132	644	263	1,114	504	100.7	1.20
3	10/2/59	165	76	97	725	411	1,345	246	157	Trace
4	10/2/59	179	89	91	811	394	1,400	441	117	Trace
6	5/16/60	145.6	70.3	133.9	652	266	1,129	504	107.8	3.50

a/ Source: Lawrence, Charles H. [5]

Geologic formations and a man-made barrier near the coast tend to constrict the outflow of ground water to the Pacific Ocean. This limitation on outflow results in an increased buildup of dissolved salts in the ground water. The degradation in quality that results from consumptive use of irrigation water by agriculture and the intrusion of connate water into the ground water table may become a limiting factor in the future usefulness of this supply of ground water.

Surface Water

The State of California presently has water quality monitoring stations at Cachuma Reservoir and downstream on the Santa Ynez River near Solvang. Table 4 shows a typical chemical analysis of surface water at the station near Solvang. The surface water here is generally calcium-magnesium sulfate-bicarbonate in character. The specific conductance normally exceeds 1,000 micromhos, and the water is extremely hard. The water generally meets the mandatory U. S. Public Health Service Drinking Water Standard for mineral content. The Santa Ynez River is periodically dry at this station.

Storage of surface water in Cachuma Reservoir has resulted in thermal stratification and planktonic blooms which have caused deterioration of water quality. These factors are discussed in more detail in Section IX of this report.

TABLE 4

CHEMICAL ANALYSIS
SURFACE WATER a/
SANTA YNEZ RIVER NEAR SOLVANG, CALIFORNIA

Constituent b/		Maximum of Record	Minimum of Record
Calcium	(Ca)	113	75
Magnesium	(Mg)	76	36
Sodium	(Na)	76	36
Potassium	(K)	7.0	1.8
Carbonate	(CO_3)	24	0.0
Bicarbonate	(HCO_3)	527	144
Sulfate	(SO_4)	294	189
Chloride	(Cl)	84	17
Nitrate	(NO_3)	7.1	0.0
Fluoride	(F)	0.95	0.2
Boron	(B)	0.72	0.00
Silica	(SiO_2)	40	10
Total Dissolved Solids		874	565
Specific Conductance (micromhos at 25°C)		1361	441
Total Hardness (as $CaCO_3$)		667	162
pH		9.4	6.8
Temperature °F		80	46
Dissolved Oxygen		16.0	4.2
Percent Saturation		142	43
Turbidity		450	5
Coliform (MPN) per ml.		7000	0.45

a/ Source: State of California [6].
b/ Concentration expressed mg/l unless otherwise noted.

VI. ECONOMY

THE PRESENT

Vandenberg Air Force Base

The economy of the study area has experienced a period of rapid growth due to the influence of Vandenberg Air Force Base. In the past, the economy of the area was largely dependent upon agricultural activities. However, the increased economic activity brought about by the reactivation of Vandenberg Air Force Base (formerly Camp Cooke) has resulted in an expanded economy which is less dependent upon agriculture.

Vandenberg AFB is located on the coast approximately 21 miles northwest of the city of Lompoc. The Base includes an area of 98,400 acres, extending 36 miles along the Pacific Coast. The Base is valued, including complete facilities and improvements, at over a billion dollars. Population, including military and civilian employees plus their families, is approximately 62,000 persons. Of this number, approximately 17,000 live on the base, the rest in surrounding communities.

The total monthly earning by the work force at Vandenberg as of April 1966, amounted to nearly 11.7 million dollars, of which 7.6 million dollars was spent off base in the local area. Base expenditures on the local market account for an additional 1.6 million dollars [7].

Vandenberg Village and Mission Hills, satellite communities to the city of Lompoc, are an outgrowth of the influx of people to Vandenberg AFB. The population of Vandenberg Village is estimated to be 5,000 and Mission Hills, approximately 2,000. The City of Lompoc also experienced an explosive growth period as a result of the reactivation of Vandenberg AFB. The 1950 population of 5,520 increased to 14,415 in 1960 and as of July 1966 was estimated to be 25,000.

The Lompoc Valley, which includes the City of Lompoc, Vandenberg AFB, Vandenberg Village and Mission Hills, had an estimated employment force of 21,500 as of July 1965. Of this number, it is estimated that 12,280, or approximately 57 percent, are directly employed in the military installation. The construction, transportation, trade and service industries also experienced increased employment because of the presence of the military base.

The initial economic stimulus of the military base was at its greatest from approximately 1958 to 1962. However, the geographic location and missile launching facilities are sufficiently important that the continuous expansion of the missile industry will create a sound economic base for the Lompoc area.

Agriculture

Climatic conditions in the Santa Ynez River Valley are very favorable to agriculture. The Lompoc area, which is referred to as the "Valley of the Flowers," claims the title of "Flower Seed Capital of The World." More than 500 varieties of sweet peas, marigolds, petunias, stock, larkspur and others are grown for the cut flower and seed market.

In the Lompoc area, truck and field crops along with flowers are the major agricultural activities. Further up the valley, the communities of Solvang, Santa Ynez, Buellton, and Los Olivos center their activities around dairying, farming, the production of alfalfa, grain, and cattle, as well as truck farming.

In 1959 approximately 18,000 acres were classified as irrigated agricultural land, with an additional 16,000 classified as non-irrigated agricultural land [8].

The value of agricultural products sold for the Santa Ynez Valley is shown in Table 5. Urbanization has decreased the agricultural acreage but the value of the products produced has increased, and will continue to play an important part in the economy of the area.

TABLE 5

VALUE OF AGRICULTURE IN THE SANTA YNEZ VALLEY [a]
(in dollars)

	1945	1954	1959
Value of Products Sold	$3,488,000	$4,390,000	$14,050,000
Field Crops	442,000	678,000	1,760,000
Fruits & Nuts	902,000	899,000	3,420,000
Vegetables	7,000	11,000	2,660,000
Forest & Horticulture Products	11,000	235,000	1,250,000
Dairy Products	468,000	679,000	1,100,000
Poultry & Poultry Products	343,000	228,000	400,000
Other Livestock Products	1,315,000	1,660,000	3,460,000

a/ Source: U. S. Department of Commerce [9]

Mining

Lompoc is the location of the largest deposits of diatomaceous earth in the world. These mineral deposits, referred to as "sea snow," are composed of minute forms of fossilized marine life. The finished product is used in the production of the finest filtering products. The mining and processing of this material presently supports an employment force of 650 persons. Oil is found in the study area and at the present time there are some eighty-two oil wells which pump more than two thousand barrels of oil daily.

THE FUTURE

Population projections for the area to be serviced by the Lompoc Project were supplied by The U. S. Bureau of Reclamation and are shown in Table 6. The large increase in population, (46,355 in 1965 to 196,620 in 2020) indicates that the pattern of increased urbanization of this historically agricultural area will continue.

TABLE 6

POPULATION PROJECTION
LOMPOC PLAIN a/

Year	Vandenberg A.F.B.	Lompoc	Vandenberg Village	Mission Hills	Total
1965	16,560	22,750	4,840	2,205	46,355
1970	18,750	32,900	5,960	3,355	60,965
2000	25,000	64,710	19,320	12,550	121,580
2020	30,000	121,630	28,330	16,660	196,620

a/ Source: U. S. Bureau of Reclamation, 1967 [10].

The present and projected labor market for the Lompoc Plain is shown in Table 7. The labor market shows the dominance of the military and government segments in the economy.

TABLE 7

LOMPOC PLAIN LABOR MARKET [a]

Labor Market	1965 Employees	1965 % Total	2020 Employees	2020 % Total
Estimated Employment, Total	21,500	100	85,000	100
Vandenberg Air Force Base	12,280	57.0	44,600	52.5
Trade (Wholesale & Retail)	2,500	11.6	11,500	13.5
Government	2,500	11.6	13,000	15.3
Service	1,700	8.0	8,200	9.6
Construction	1,000	4.7	4,200	4.9
Mining	650	3.0	900	1.1
Agriculture	400	1.9	400	0.5
Utilities	300	1.4	1,400	1.7
Finance	170	0.8	800	0.9

a/ Source: Lompoc Valley Chamber of Commerce [11].

VII. WATER USES - PRESENT AND FUTURE

Water supplies for domestic, industrial, and agricultural use are presently obtained from ground water aquifers. The present use of approximately 30,000 acre-feet per year includes about 19,000 acre-feet for irrigation and 11,000 acre-feet for municipal and industrial uses.

Projections of municipal and industrial water requirements for the service area were supplied by the U. S. Bureau of Reclamation and are shown in Table 8. Future water requirements for agriculture were not projected, but the continued urbanization of the area will decrease the irrigated agricultural acreage.

The combined surface and ground water resources in the study area will not be adequate to meet the projected water requirements for municipal and industrial needs; thus, it will be necessary to import water into the basin. Santa Barbara County has contracted for a maximum annual entitlement of 57,700 acre-feet from the California Water Plan [12]. This supply has not been allocated to any specific areas within the county at the present time. A combination desalination and power plant on the coast of Santa Barbara County is also a possible source of future supplies for the area [13].

Construction of Cachuma Reservoir in 1953 eliminated most of the steelhead trout spawning grounds in the Santa Ynez River. Completion of Lompoc Reservoir will provide for esentially complete development of the runoff the Santa Ynez River. Preliminary assessment of the U. S. Bureau of Sport Fisheries and Wildlife indicates that due to the shortage of water it will be impracticable to maintain a fishery in the river below Lompoc Reservoir. However, the Bureau of Reclamation has indicated that an annual release of 3,500 acre-feet will be made to supplement flow in the river in order to maintain a lagoon and marsh area located in the river reach below the proposed dam.

Project plans provide for the development of a warm-water fishery in Lompoc Reservoir. The Bureau of Sport Fisheries and Wildlife have projected that, with optimum fishery facilities and an average annual pool of 210,000 acre-feet, maximum annual use of the reservoir will reach 420,000 angler-days within 20 years after completion of the project, and will stabilize at 360,000 angler-days by 50 years after completion of the project.

TABLE 8

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS
LOMPOC PLAIN a/

(Acre-Feet)

Year	Vandenberg A.F.B. b/	Greater Lompoc c/			Total
		Lompoc	Vandenberg Village	Mission Hills	
1965	6,500	3,720	791	361	11,372
1970	7,400	5,601	1,015	571	14,587
2000	9,800	13,625	4,068	2,642	30,135
2020	11,800	28,607	6,663	3,918	50,988

a/ Source: U. S. Bureau of Reclamation, 1967 [10].

b/ Estimated 35% municipal (domestic support use) and 65% industrial (missile support use)
Unit Use = 350 gpcd

c/ Estimated 90% municipal use and 10% light industrial use
Unit Use = Year gpcd
1965 146
1970 152
2000 188
2020 210

VIII. WATER QUALITY CONTROL NEEDS

WASTE SOURCES

The City of Lompoc provides secondary treatment followed by oxidation ponds before discharging to the Santa Ynez River approximately ten miles from its mouth. The present discharge of 2.1 million gallons per day exceeds the design capacity of 1.76 million gallons per day. Vandenberg Air Force Base with 17,000 permanent residents provides secondary treatment and discharges effluent directly to the Pacific Ocean. Vandenberg Village treats its waste water by means of a trickling filter system before disposal to land by means of sprinklers. Mission Hills provides primary settling followed by a double lagoon system before discharging to land. The small communities of Santa Ynez and Los Olivos utilize individual septic tanks and leaching fields. The town of Buellton (population 2,000) utilizes aeration and settling tanks before being discharged to percolation beds near the Santa Ynez River or used as irrigation water. Solvang (population 2,000) uses a system of settling tanks and sludge lagoons followed by discharge to percolation beds near the Santa Ynez River [14]. Some of the waste water is used as irrigation water. The Federal Correctional Institution provides secondary treatment followed by oxidation ponds before discharging to the Sant Ynez River. The Cachuma County Recreation Area, located downstream from Cachuma Dam and Reservoir, utilizes spray irrigation on hillsides to dispose of its waste effluent. Design capacity of this system is 0.18 million gallons per day and it is intended to serve approximately 3,500 persons.

The City of Lompoc is presently investigating the feasibility of a waste water reclamation system that would provide recharge to the ground water reservoir by means of a percolation basin located in the Santa Ynez River bed.

Waste discharges to the Santa Ynez River (1967) are listed in the following table. The amount of biochemical oxygen demand discharged was computed by using a waste load factor for five-day BOD of 0.17 pounds per day per capita and a treatment efficiency of 85 percent BOD_5 removal.

TABLE 9

MUNICIPAL WASTE SOURCES
SANTA YNEZ RIVER BASIN
1967

Loading Point	Population	BOD_5 Discharged lb/day	Discharge
Vandenberg AFB	17,000	450	Pacific Ocean
Lompoc	25,000	640	Santa Ynez River
Vandenberg Village	5,000 a/	130	Land
Mission Hills	2,000 a/	50	Land
Buellton	2,000 a/	50	Land
Solvang	2,000 a/	50	Land
Federal Correctional Institution	1,700	45	Santa Ynez River

a/ Estimated Population

Based on the projected population for the year 2020 and an average treatment efficiency of 85 percent, an organic load of 5,000 pounds of BOD_5 per day will be discharged in the area below Lompoc Reservoir.

All waste effluents should be discharged on land or to the ocean in the future. The City of Lompoc is presently investigating the feasibility of waste water reclamation by ground water recharge. Ground water recharge would provide a more efficient use of the scarce water resources in that the water could be reused, and the present mineral quality of the ground water would be improved. The magnitude and the benefit of such an improvement was not determined.

WATER QUALITY CRITERIA

The Central Coastal Regional Water Quality Control Board is the State agency concerned with the regulation of waste discharges to protect beneficial uses of water in the Santa Ynez Valley. The Board recognizes that runoff and waste water discharged to the Santa Ynez River and to land in the basin percolates to ground water aquifers that are an important source of domestic and industrial water supply. The Board requires treatment and disinfection of all effluents to prevent contamination of usable ground water aquifers. The Board further prescribes that at times when there is no natural stream flow in the river at the point of discharge, the city of Lompoc shall maintain the effluent within a definite area of the river bed rather than permitting it to flow downstream uncontrolled. During periods when stream flow in the river is sufficient to support fish life the Board requires that the dissolved oxygen shall not be depressed below 5 parts per million at any point as a result of the discharge.

The lagoon at the mouth of the Santa Ynez River is utilized for water contact sports and supports a sports fishery. The Board specifies that Vandenberg AFB must provide disinfection of effluent and an outfall system to the ocean, thereby preventing hazards to recreationists.

In view of the proposed development of the Lompoc Project, water quality control policy for the Santa Ynez River Basin will be reevaluated by the Regional Water Quality Control Board. The city of Lompoc is presently considering waste water reclamation by ground water recharge. At the present time flow in the Santa Ynez River is essentially zero during the period June to December, the period of zero flow will be extended by development of the Lompoc Project. Under these future flow conditions, uncontrolled discharge of treated waste water directly into the Santa Ynez River should be prohibited. Discharge to land, discharge to the ocean, or waste water reclamation by means of controlled percolation facilities located within the river channel should be encouraged in order to avoid discharging to a river-bed that will have zero or nearly zero flow during a large part of the year.

Waste discharge to the Santa Ynez River above Lompoc Reservoir will require adequate treatment to protect the quality of water in Lompoc Reservoir for municipal and industrial purposes. Downstream releases from Cachuma Reservoir to satisfy prior water rights vary from 3000 to 4000 acre-feet annually and the stream will have periods of zero flow. Therefore, in order to protect benefits to wildlife and aesthethic value of the stream, camping and recreational activities along the Santa Ynez River should be controlled and regulated to prevent direct contamination of surface water. Buellton, Solvang, and other communities directly upstream of Lompoc Reservoir should be prohibited from discharging directly to the river in order to minimize contamination of the stream and to control nutrient loading of Lompoc Reservoir.

The maintenance of water quality in the reservoir has added significance since a warm-water fishery will be developed and the reservoir itself will receive heavy recreational use, including water contact sports. Thus, establishment of water quality criteria for Lompoc Reservoir should include consideration of aesthethic enjoyment as a beneficial use of the reservoir.

FLOW REGULATION REQUIREMENTS

The Lompoc Project will provide nearly complete development of surface runoff of the Santa Ynez River. Beneficial use of water downstream from Lompoc Reservoir will be negligible. Therefore, there is no requirement for storage in Lompoc Reservoir for the purpose of flow regulation for water quality control.

IX. EFFECTS OF PROJECT ON WATER QUALITY

WATER QUALITY IN THE RESERVOIR

Evaluation of the possible influence of the proposed Lompoc Project on water quality is facilitated by several water quality surveys conducted at Cachuma Reservoir. The Cachuma Reservoir is located on the Santa Ynez River approximately 25 miles upstream from the site of the proposed Lompoc Project. Environmental and physical conditions are sufficiently similar to allow a meaningful comparison of probable water quality conditions in the two reservoirs.

Since completion of Cachuma Reservoir in 1953, several water quality problems have arisen. Complaints of objectionable tastes and odors in project water caused the Carpinteria, Goleta, Montecito, City of Santa Barbara, and Summerland County water districts to retain Ralph Stone and Company to conduct a water quality study of the Cachuma Project. This engineering firm conducted a continuous study from 1959 to 1961. The results of this study were reported in 1959 [15] and 1961 [16]. These two reports serve as a basis for estimating future conditions in the proposed Lompoc Reservoir.

Cachuma Reservoir experiences water quality problems associated with high water temperatures and nutrient enrichment. Surface temperatures vary from 55 to 70°F, while bottom temperatures vary from 54 to 50°F. The reservoir begins to stratify in April and remains thus until late November or early December.

Taste and odor problems increase in intensity during the summer months. It is believed that the primary source of taste and odor problems is the bacterium, Actinomycetes. High sulfide concentrations in the reservoir and from the ground water infiltrating into the delivery system also contribute to the taste and odor problem. Hydrogen sulfide was observed in the bottom waters of the reservoir in early June and reached concentrations of 3.0 mg/liter in some parts of the reservoir later in the summer. Sulfides disappeared from the reservoir after the fall turnover in November or December.

Algal activity in the reservoir is also believed to affect taste and odor of the reservoir waters. The blue-green algae that are dominant in the reservoir during the summer months are a known cause of taste and odor problems elsewhere. A survey in 1959 indicated that the highest algae density occurred in July when the SAU [a] values were 25,000 offshore, 63,000 near the north shore, and 402,500 near the south shore. Algae die and drop to the bottom where they are decomposed and contribute to low dissolved oxygen in lower levels of the reservoir. The algae in the reservoir are also a primary food source for the bacteria. The diatoms, Fragilaria and Stepnadiscus, are present in dominate numbers during the months of November and December. Mougeotia, a green alga, is dominant in January and February. Attached algae, largely Cladophora, grow profusely in shallow water on brush and rocks.

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a/ SAU = 20 square microns

The algae present contribute to a high turbidity, which varies from 10 to 40 mg/l near the surface of the reservoir. Below eighteen feet the turbidity is less than 10 mg/l. During December there is very little turbidity because of the low algal density and the very small runoff.

The dissolved oxygen concentration at the surface varied from 9.5 mg/l (115 percent of saturation) in July to 5.4 mg/l (50 percent of saturation) in December. The principal factors affecting surface dissolved oxygen were algal photosynthesis and respiration and vertical mixing. Stratification began in April and by early June many of the samples taken below 54 feet were devoid of oxygen. As summer progressed, the depth of complete oxygen depletion rose to the 36 foot level in parts of the reservoir. The December turnover resulted in a dissolved oxygen of 5.4 mg/l at the surface and 5.3 mg/l at the 64 foot level throughout the reservoir. The highest recorded dissolved oxygen at the 64 foot level was 6.8 mg/l which occurred in January.

The Ralph Stone studies indicated that chemical quality did not vary significantly from month to month. The total dissolved solids ranged from a low of 580 mg/l to a high of 613 mg/l, for an average 602.5 mg/l. The average sulfate content was 222 mg/l. The highest total hardness as calcium carbonate was 396 mg/l and the average 356.6 mg/l. The average total nitrogen, phosphate (PO_4) nd potassium concentrations were 9.33, 1.0, and 2.5 mg/l, respectively.

The prevailing wind is from the northeast and is responsible for the tendency of algae to accumulate near the southern shoreline. It is important that the effect of wind and other variables that effect the hydrologic flow pattern of the Lompoc Reservoir be evaluated so as to control most effectively the quality of withdrawals from the proposed reservoir. The accumulation of organisms near the outlet works, reservoir clearing, livestock and wildlife watering and improper shoreline be avoided in the Lompoc Project. The present plan for a multi-level outlet at the new reservoir is well justified by the water quality problems experienced at the Cachuma Reservoir.

In order to reduce the probability of water quality problems similar to those experienced at Cachuma Reservoir it is desirable that plans for reservoir site clearing provide for the careful removal of organic materials that will contribute to the nutrient enrichment of the reservoir. All brush, stumps, logs, grass, as well as man or animal made debris and waste should be removed from the reservoir site so that nutrients will not cycle back to stored water. If possible, the reservoir bottom area should be flushed several times before use in order to collect debris for disposal, to remove readily soluble soil mineral constituents, and to wash out fine nutrient laden soil particles. Laboratory experiments indicate that several water exchanges or flushing, each of about 3 weeks duration is effective in leaching nutrients that would enrich the waters of the reservoir /17/.

The U. S. Geological Survey in cooperation with the Santa Barbara County Water Agency has determined that it is possible to prevent stratification of Lake Cachuma by means of air injection [18]. The result of this study indicates that destratification by air injection would reduce the evaporation rate, reduce undesirable dissolved gases that are associated with taste and odor problems, and increase the dissolved oxygen content of reservoir water. Studies are continuing to determine the feasibility of constructing an air injection system at Lake Cachuma.

Due to the long carry-over period of storage in the Lompoc Reservoir, the concentration effect of evaporation will produce a significant change in the quality of water that is stored in the reservoir. The increase in the concentration of total dissolved solids (TDS) and hardness due to evaporation was estimated by means of an operational study using runoff data for the period 1904 to 1962. The concentration of TDS was found to vary from a minimum of 400 mg/l to a maximum of 1500 mg/l and averaged 725 mg/l. The hardness as calcium carbonate varied from 415 mg/l to 735 mg/l and averaged 525 mg/l.

EFFECTS OF PROJECT CONSTRUCTION

During the construction of the project, adequate measures must be taken to protect both surface and ground waters. Provisions should be included in contract specifications so contractors would be cognizant of requirements to protect water quality in the work area. Silt detention basins should be constructed at all work areas to eliminate excessive turbidity leaching from earth work. In equipment maintenance areas, special precautions should be taken to contain spilled fuel, lubrication products and wash water. Sewage from construction camps should be contained on land. All construction activities affecting water quality should comply with requirements of local and state water quality control authorities. Comments from the Federal Water Pollution Control Administration should be requested by the construction agency during the preparation of project plans and specifications in compliance with Executive Order 11288.

X. BENEFITS

The water available from the Lompoc Project will be of superior quality in certain respects to the presently used ground water source. The Lompoc water will have an average dissolved solids concentration of 725 mg/l and a total hardness of 525 mg/l. The approximate concentration of total dissolved solids in the ground water is 1170 mg/l and the average hardness is 650 mg/l in the Greater Lompoc Area (Lompoc, Vandenberg Village and Mission Hills) and approximately 1270 mg/l and 500 mg/l, respectively, at Vandenberg Air Force Base. The City of Lompoc is presently producing a treated municipal water supply with an approximate hardness of 150 mg/l at a cost of approximately seventy dollars ($70) an acre-foot [5].

A number of studies have been made to determine differential penalty costs associated with using waters of different quality. Four such studies [19-22] developed penalty costs of $0.036, $0.040, $0.042, and $0.057 per acre-foot per milligram per liter of total dissolved solids for industrial uses. Based upon these results, a unit value of $0.040 per acre-foot per milligram per liter of total dissolved solids appears reasonable as a penalty cost for industrial use.

Based upon the cost of reducing hardness by treatment, the Stanford Research Institute [22] derived a differential cost of $0.024 per acre-foot per milligram per liter hardness for domestic water supplies.

An estimate of the economic value of the average difference in water quality of Lompoc Reservoir and the present ground water supply of the Greater Lompoc Area is shown in Table 10. The value of the quality difference for Vandenberg AFB is shown in Table 11. The total annual equivalent value of the quality difference to the local users is $161,520 and the total present (1970) worth is $4,930,400. These water supply quality benefits accrue without storage for flow regulation for water quality control. Benefits accrue to the water users which are identifiable and a collection system for recovery of costs exists. Therefore, benefits are considered to be water supply quality benefits rather than water quality control benefits as specified in Section 3b of the Federal Water Pollution Control Act as ammended (33 U.S.C. 466 et seq.).

TABLE 10

MUNICIPAL AND INDUSTRIAL WATER SUPPLY BENFITS
GREATER LOMPOC AREA

Year	Municipal Use (AF)	Value (dollars)	Present (1970) Annual Value (dollars) a/	Industrial Use (AF)	Value (dollars)	Present (1970) Annual Value (dollars) a/
1970	6,470	19,410	19,410	717	12,760	12,760
1980	10,500	31,500	10,150	1,200	21,360	7,200
2020	10,500	31,500	—	1,200	—	—

a/ Interest Rate 3.125 percent, evaluation period 100 years.

Annual Equivalent Value, Municipal,	29,560
" " " , Industrial,	19,960
Total Present Annual Equivalent Value	49,520
Total Present Worth (1970)	$1,511,600

TABLE 11

MUNICIPAL AND INDUSTRIAL WATER SUPPLY BENEFITS
VANDENBERG AIR FORCE BASE

Year	Municipal Use (AF)	Value (dollars)	Present (1970) Annual Value (dollars) [a/]	Industrial Use (AF)	Value (dollars)	Present (1970) Annual Value (dollars) [a/]
1970	2590	0	—	4810	105,000	105,000
1980	2900	0	—	5400	113,400	7,000
2020	2900	0	—	5400	—	—

a/ Interest Rate 3.125 percent, evaluation period 100 years.

Present Annual Equivalent value, Municipal	0
" " " " , Industrial	112,000
Total Present Annnal Equivalent Value	112,000
Total Present Worth (1970)	3,418,800

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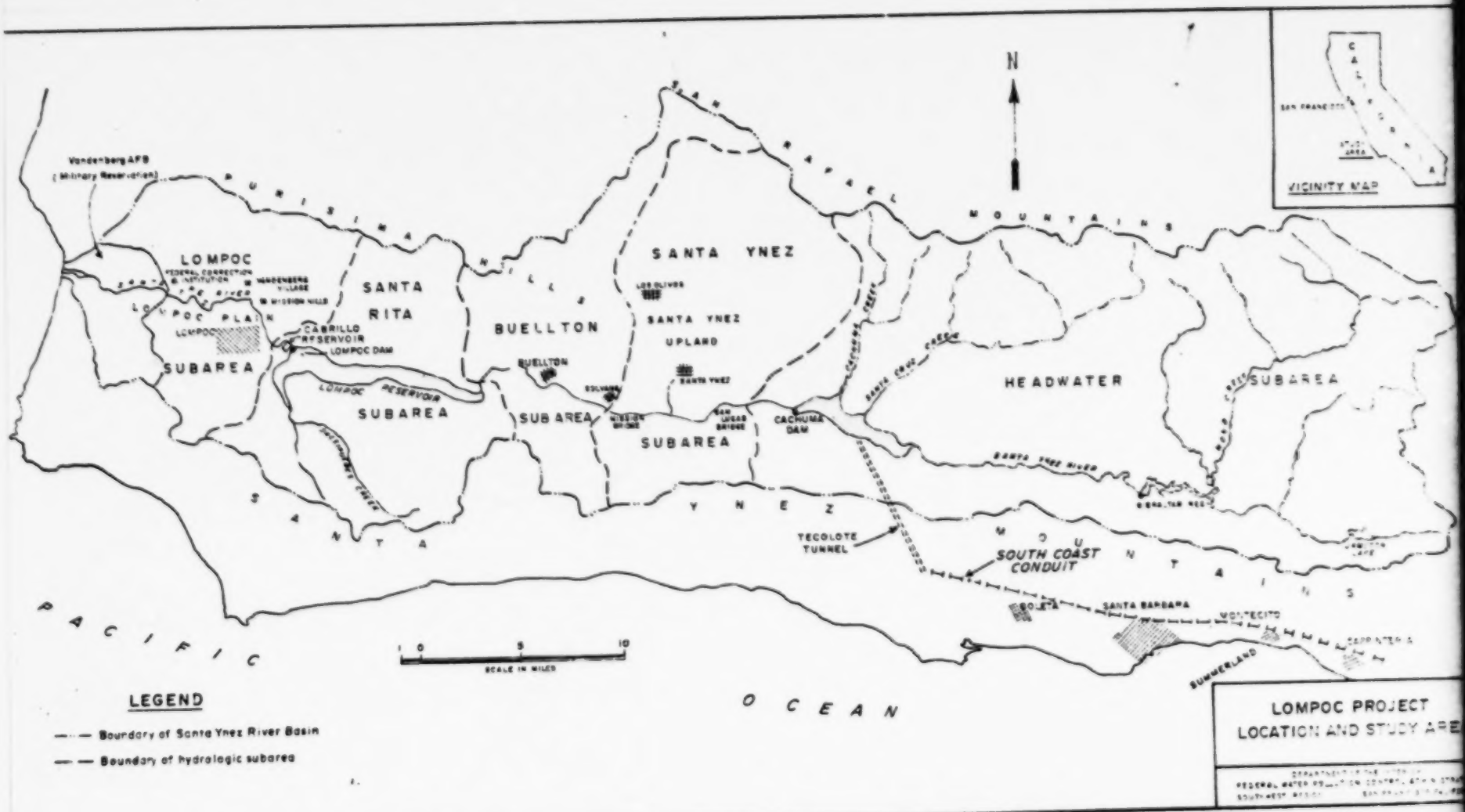
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VICINITY MAP
Vandenberg AFB
(Military Reservation)
LOMPOC
SANTA RITA
SUBAREA
LOMPOC PLAIN
CABRILLO RESERVOIR
LOMPOC DAM
LOMPOC RESERVOIR
SUBAREA
BUELLTON
SUBAREA
SANTA YNEZ
SANTA YNEZ UPLAND
SUBAREA
CACHUMA DAM
HEADWATER
SUBAREA
SANTA YNEZ MOUNTAINS
TECOLOTE TUNNEL
SOUTH COAST CONDUIT
SANTA BARBARA
MONTECITO
SUMMERLAND
CARPINTERIA
PACIFIC
OCEAN
0 5 10
SCALE IN MILES
LEGEND
Boundary of Santa Ynez River Basin
Boundary of hydrologic subarea
LOMPOC PROJECT
LOCATION AND STUDY AREA